Voyager Bulletin

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Mission Highlights

Detail Increases

As Voyager 1 draws nearer the giant planet, the cameras are showing increasing detail. The circulation patterns, especially around the Great Red Spot, are becoming more discernible. Much attention will be focussed on the Red Spot itself to determine its wave pattern – is the center swirling while the edges are quiet, or is the center quiet while the edges flow? Now known to be purely an atmospheric feature, the Red Spot was once thought to be anchored to a surface feature, which would have explained its longevity. Its size has decreased in recent years.

Increasing detail in the belts (dark bands) and zones (light bands) also shows interesting features. The zones are thought to be rising, while the belts are descending. At their interfaces, wind shears result, accounting for the turbulent features observed in these areas.

"Hot spots" can be seen below the Red Spot, to the left and right. Specific spacecraft sequences will target to these and other interesting features.

Voyager 1 Activities

The daily system scans, infrared mapping, ultraviolet searches, and imaging sequences of the observatory phase will continue next week. "Tweaking" of the scan platform pointing is planned to "fine tune" the centering of the planet in the instruments' fields of view.

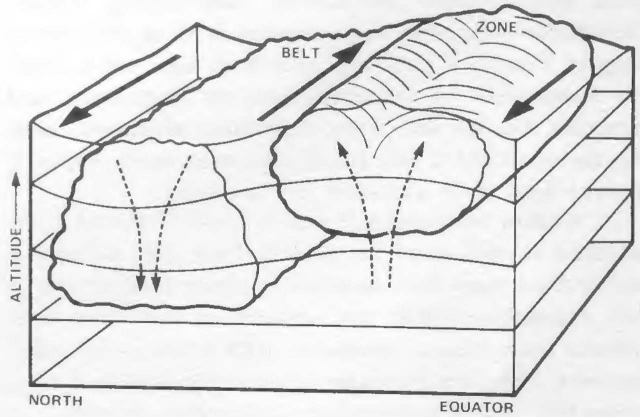
The IRIS is operating well after its warming sequence in late December.

Voyager 2

The trailing spacecraft remains relatively quiet, with routine tests and calibrations at cruise level. The IRIS has undergone a heating period to maintain good performance in the interferometer's Michelson motor.

Another test of a link between the Stanford radio telescope and the planetary radio astronomy antennas is planned for the near future in further analysis of the PRA's capability should Voyager 2's remaining radio receiver fail.

WIND SHEARS – An atmospheric system larger than Earth and more than 300 years old, the Great Red Spot remains a mystery and a challenge to Voyager's instruments. In this picture taken by Voyager 1 on January 9 through a blue filter, swirling, storm-like features possibly associated with wind shear can be seen both to the left and above the Red Spot. Analysis of motions of the features will lead to a better understanding of Jovian weather. The spacecraft was 54 million kilometers (34 million miles) from the planet at this point.



CIRCULATION – Current models of Jupiter's atmosphere theorize rising zones and descending belts.

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The Voyager Spacecraft

Part 13 — Ultraviolet Spectrometer

Hydrogen, helium, and methane — hardly a mixture of which one would wish to take a deep breath. Yet these are the expected major constituents of the atmospheres at the outer planets.

Voyager's ultraviolet spectrometer (UVS) will study the composition and structure of the atmospheres of Jupiter, Saturn, possibly Uranus, and their satellites, as well as stellar sources of ultraviolet radiation.

Scientific Goals

Two rather different techniques have been developed for spectroscopically probing planetary atmospheres from the Earth or passing spacecraft (as opposed to landers or penetrators). Airglow observations require a large collecting area for maximum sensitivity to weak emissions found high in the atmospheres where collisions between the gas atoms and molecules are infrequent. Occultation measurements, on the other hand, require an instrument which can look directly at the Sun, using it as a source of ultraviolet radiation to measure absorption and scattering by the atmosphere as the spacecraft moves into the planet's or satellite's shadow.

Voyager's UVS combines these two types of spectrometers with a common detector system.

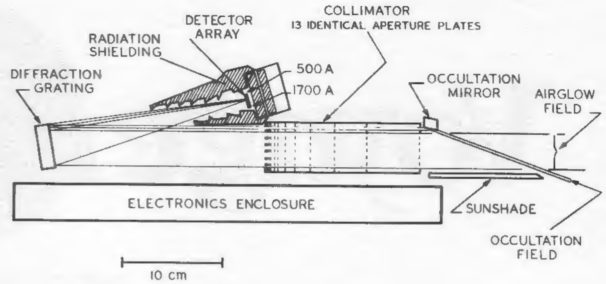
Airglow observations will measure the distribution of atomic hydrogen and helium in the upper atmosphere by recording the resonance scattering of sunlight. Resonance scattering arises by atoms or molecules absorbing solar radiation at characteristic wavelengths and re-radiating at the same wavelength. This differs from fluorescence in which the activating wavelength is absorbed and the energy is emitted at longer wavelengths.

As the Sun is occulted by the planet (blocked from the spacecraft's view), the planet's atmosphere moves slowly between the Sun and the instrument. Since all common atmospheric components have strong, readily-identifiable absorption characteristics in these short wavelengths, Voyager's UVS will be able to learn much about the composition of the atmosphere, its temperature, and structure. The key will be not the amount of sunlight entering the atmosphere, but rather what happens to it after it enters — how it is absorbed and scattered.

Airglow measurements will be made of several of the satellites as well as of the planets. Hydrogen, potassium, and sodium have been detected in direct observations of Io's atmosphere, while the presence of sulfur has been inferred from indirect association with Io's cloud of sulfur particles. The UVS is capable of measuring distributions of minor gases and Io's atmospheric temperature, as well.

Auroral activity on Ganymede, another of Jupiter's Galilean satellites, may confirm water ice on the satellite's surface by permitting measurements of atomic oxygen.

The UVS will contribute to mapping the torus clouds around the planets and satellites, especially the hydrogen cloud around Io. The "circumference" and out-of-plane thickness of the cloud are of great interest; that is, how far does it extend above and below the plane of Io's orbit? In mid-February, the slit will be oriented both perpendicular



and parallel to the orbital plane in special spacecraft maneuvers to help measure the extent of the gas clouds around Jupiter.

The UVS will also observe Io's "flux tube", the region of interaction between Io and Jupiter's magnetic field. Spectral analysis of Jupiter's atmosphere where the flux tube contacts the planet should be revealing.

Grating Spectrometer

The UVS detects and measures ultraviolet radiation in the range from 500 to 1700 Angstroms, at 128 contiguous intervals. Included in this range are the hydrogen Lyman series molecular hydrogen, helium, methane, acetylene, ethane, and other atmospheric hydrocarbons.

Light enters the UVS instrument through an aperture which has two fields of view (FOVs). During the occultation mode, the main FOV (0.9 by 0.1 degree) for airglow measurements is shielded by the sunshade. The occultation FOV (0.9 by 0.3 degree) is also offset 20 degrees from the airglow FOV so that the instrument can be pointed at the Sun with no damage from direct sunlight to the airglow FOV and the other scan platform instruments.

After entering the aperture, the light passes through a set of 13 identical aperture plates (the mechanical collimator). (Wavelengths shorter than 1050 Angstroms cannot be transmitted by an optical collimator, but can be by the mechanical one.) The collimator restricts the field of view to the concave diffraction grating which has been ruled at 540 lines per millimeter by diamond point. The radiation is reflected from the grating and dispersed onto the ultraviolet detector where it is converted to electrical pulses indicating the number of photons (measurable units of light) at particular wavelengths in the extreme ultraviolet.

Mounted on the scan platform, the UVS weighs 4.5 kilograms (10 pounds) and was fabricated by TRW Systems, Redondo Beach, California, under contract to the designer, Kitt Peak National Observatory, Tucson, Arizona.

Investigators

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